

CLAIMS

1. A heat exchanger comprising a heat exchanger component having a surface covered with an Al-Si alloy layer, the Al-Si alloy layer having a fluoride layer formed in a surface layer portion thereof, the Al-Si alloy layer of the heat exchanger component having a portion up to 1.65 mass % in Si content.

2. A heat exchanger according to claim 1 wherein the fluoride layer is 2 nm to 10 μ m in thickness.

3. A heat exchanger according to claim 1 wherein the fluoride layer comprises a fluoride produced by subjecting a surface of the Al-Si alloy layer of the heat exchanger component to a fluorination treatment.

4. A heat exchanger according to claim 1 wherein an anodic oxide coating is formed over a surface of the Al-Si alloy layer of the heat exchanger component, and a plating layer containing nickel is formed over a surface of the anodic oxide coating, the fluoride layer being formed on a surface of the plating layer and comprising a fluoride produced by subjecting the surface of the plating layer to a fluorination treatment.

5. A heat exchanger according to claim 1 wherein the fluoride layer is provided over a surface thereof with at least one superposed layer group comprising a plating layer containing nickel and a fluoride layer comprising a fluoride produced by subjecting a surface of the plating layer to a fluorination treatment.

6. A heat exchanger according to claim 1 wherein the heat exchanger component comprises a core layer of pure aluminum

or aluminum alloy, and an Al-Si alloy layer covering each of opposite surfaces of the core layer, the core layer containing Si diffused thereinto from the Al-Si alloy layer, the Al-Si alloy layer having a portion up to 1.65 mass % in Si content.

5 7. A heat exchanger according to claim 6 wherein at least one surface of the heat exchanger component is exposed to a fluid containing an acid component.

8. A heat exchanger according to claim 1 wherein the heat exchange component has a portion comprising a core layer of
10 pure aluminum or aluminum alloy, and two Al-Si alloy layers covering respective opposite surfaces of the core layer, and an intermediate layer of pure aluminum is formed between one of the Al-Si alloy layers and the core layer, the intermediate layer containing Si diffused thereinto from the Al-Si alloy
15 layer, the Al-Si alloy layer adjacent to the intermediate layer having a portion up to 1.65 mass % in Si content.

9. A heat exchanger according to claim 1 wherein the heat exchange component comprises a core layer of pure aluminum
or aluminum alloy, and two Al-Si alloy layers covering respective
20 opposite surfaces of the core layer, and an intermediate layer of pure aluminum is formed between each of the Al-Si alloy layers and the core layer, the intermediate layer containing Si diffused thereinto from the Al-Si alloy layer, the Al-Si alloy layer having a portion up to 1.65 mass % in Si content.

25 10. A heat exchanger according to claim 8 or 9 wherein the pure aluminum making the intermediate layer has added thereto Zr and/or Mg in a total amount of 0.1 to 0.25 mass %.

11. A heat exchanger according to claim 8 or 9 wherein

the intermediate layer has a thickness in a proportion of 5 to 25% of the entire thickness taken as 100% of the heat exchanger component.

12. A heat exchanger according to claim 8 or 9 wherein
5 a surface of the heat exchanger component on the side thereof where the intermediate layer exists is exposed to a fluid containing an acid component.

13. A heat exchanger according to claim 1 which comprises
a plurality of parallel hollow bodies each having a fluid channel
10 inside thereof and fins arranged between and brazed to respective pairs of adjacent flat hollow bodies, the heat exchanger component being each of the flat hollow bodies.

14. A heat exchanger according to claim 1 which comprises
a plurality of parallel hollow bodies each having a fluid channel
15 inside thereof and fins arranged between and brazed to respective pairs of adjacent flat hollow bodies, each of the hollow bodies comprising two plates brazed to each other at peripheral edge portions thereof, the two plates defining therebetween a bulging fluid channel and a bulging header-forming portion communicating
20 with each of opposite ends of the fluid channel, the heat exchanger component being each of the plates.

15. A heat exchanger according to claim 13 or 14 wherein
a fluid containing an acid component flows through at least one of the fluid channel inside each of the flat hollow bodies
25 and a clearance between each pair of adjacent flat hollow bodies.

16. A heat exchanger according to claim 13 or 14 wherein
fuel hydrogen gas produced by reforming in a fuel cell system
flows through a clearance between each pair of adjacent flat

hollow bodies, and an outer peripheral surface of each of the flat hollow bodies is covered with an Al-Si alloy layer, a fluoride layer being formed in a surface layer portion of the Al-Si alloy layer, the Al-Si alloy layer having a portion up to 1.65 mass % in Si content, a catalyst for selectively oxidizing CO being provided on the outer peripheral surface of each of the flat hollow bodies and on a surface of each of the fins, the catalyst being serviceable to diminish CO in the fuel hydrogen gas.

10 17. A fuel cell system comprising a heat exchanger according to any one of claims 1 to 16 for diminishing CO.

18. A fuel cell motor vehicle having installed therein a fuel cell system according to claim 17.

15 19. A cogeneration system comprising a fuel cell system according to claim 17.

20 20. A process for fabricating a heat exchanger characterized by making plates each having a channel-forming bulging portion and a header-forming bulging portion bulging to a greater extent than the bulging portion and extending from each of opposite ends of the channel-forming bulging portion, from a brazing sheet comprising a core of pure aluminum or aluminum alloy and a cladding of Al-7.5-12.5 wt. % Si alloy brazing material covering each of opposite sides of the core, arranging the plates in superposed pairs each comprising the combination of two plates with openings of the bulging portions of each type opposed to each other in corresponding relation so that outer surfaces of bottom walls of the header-forming bulging portions of the adjacent pairs are in contact with each other

and arranging fins of bare pure aluminum or aluminum alloy between portions corresponding to the channel-forming bulging portions of the respective adjacent pairs of plates, preheating the resulting combination of the pairs of plates and the fins
5 to diffuse the Si in the cladding of the brazing sheet providing the plates into the core, brazing the two preheated plates in each pair to each other along the peripheral edge portions thereof to form a flat hollow body, brazing the fins to the respective adjacent pairs of flat hollow bodies, and heating
10 the brazed assembly of the flat hollow bodies and the fins in an atmosphere containing a fluorinating gas to form a fluoride layer over surfaces of the flat hollow bodies and surfaces of the fins.

21. A process for fabricating a heat exchanger characterized
15 by making plates each having a channel-forming bulging portion and a header-forming bulging portion bulging to a greater extent than the bulging portion and extending from each of opposite ends of the channel-forming bulging portion, from a brazing sheet comprising a core of pure aluminum or aluminum alloy,
20 a cladding of Al-7.5-12.5 wt. % Si alloy brazing material covering each of opposite sides of the core, and an intermediate layer of pure aluminum formed between the core and the cladding over at least one of the opposite sides thereof, arranging the plates in superposed pairs each comprising the combination of two
25 plates with openings of the bulging portions of each type opposed to each other in corresponding relation so that outer surfaces of bottom walls of the header-forming bulging portions of the adjacent pairs are in contact with each other and arranging

fins of bare pure aluminum or aluminum alloy between portions corresponding to the channel-forming bulging portions of the respective adjacent pairs of plates, preheating the resulting combination of the pairs of plates and the fins to diffuse
5 the Si in the cladding of the brazing sheet providing the plates into the core, brazing the two preheated plates in each pair to each other along the peripheral edge portions thereof to form a flat hollow body, brazing the fins to the respective adjacent pairs of flat hollow bodies, and heating the brazed
10 assembly of the flat hollow bodies and the fins in an atmosphere containing a fluorinating gas to form a fluoride layer over a surface of each of the flat hollow bodies on the core side thereof where the intermediate layer exists and over surfaces of the fins.

15 22. A process for fabricating a heat exchanger according to claim 21 wherein the pure aluminum providing the intermediate layer of the brazing sheet making the plates has added thereto Zr and/or Mg in a total amount of 0.1 to 0.25 mass %.

20 23. A process for fabricating a heat exchanger according to claim 21 wherein the intermediate layer of the brazing sheet providing the plates has a thickness in a proportion of 5 to 25% of the entire thickness taken as 100% of the brazing sheet.

24. A process for fabricating a heat exchanger according to claim 20 or 21 wherein the core of the brazing sheet providing
25 the plates and the fins are each made of JIS A3003 alloy.

25. A process for fabricating a heat exchanger according to claim 20 or 21 wherein the cladding of the brazing sheet providing the plates has a thickness in a proportion of 2 to

25% of the entire thickness taken as 100% of the brazing sheet.

26. A process for fabricating a heat exchanger according to claim 20 or 21 wherein the fluorinating gas is at least one gas selected from the group consisting of fluorine gas, chlorine trifluoride gas and nitrogen fluoride gas, and the fluorinating gas is diluted with an inert gas to prepare the atmosphere.

27. A process for fabricating a heat exchanger according to claim 26 wherein the atmosphere contains the fluorinating gas at a concentration of 5 to 80%.

28. A process for fabricating a heat exchanger according to claim 26 wherein the atmosphere contains the fluorinating gas at a concentration of 10 to 60%.

29. A process for fabricating a heat exchanger according to claim 20 or 21 wherein a catalyst for selectively oxidizing CO is provided on outer peripheral surfaces of the flat hollow bodies and on surfaces of the fins after the fluoride layer is formed.

30. A product of pure aluminum or aluminum alloy comprising a component having a surface covered with an Al-Si alloy layer, the Al-Si alloy layer having a fluoride layer formed on a surface layer portion thereof, the Al-Si alloy layer of the component having a portion up to 1.65 mass % in Si content.

31. A product of pure aluminum or aluminum alloy according to claim 30 wherein the fluoride layer is 2 nm to 10 μ m in thickness.

32. A product of pure aluminum or aluminum alloy according to claim 30 wherein the fluoride layer comprises a fluoride

produced by subjecting a surface of the Al-Si alloy layer of the component to a fluorination treatment.

33. A product of pure aluminum or aluminum alloy according to claim 30 wherein an anodic oxide coating is formed over a surface of the Al-Si alloy layer of the component, and a plating layer containing nickel is formed over a surface of the anodic oxide coating, the fluoride layer being formed over a surface of the plating layer and comprising a fluoride produced by subjecting the surface of the plating layer to a fluorination treatment.

34. A product of pure aluminum or aluminum alloy according to claim 30 wherein the fluoride layer is provided over a surface thereof with at least one superposed layer group comprising a plating layer containing nickel and a fluoride layer comprising a fluoride produced by subjecting a surface of the plating layer to a fluorination treatment.

35. A product of pure aluminum or aluminum alloy according to claim 30 wherein the component comprises a core layer of pure aluminum or aluminum alloy, and an Al-Si alloy layer covering each of opposite surfaces of the core layer, the core layer containing Si diffused thereinto from the Al-Si alloy layer, the Al-Si alloy layer having a portion up to 1.65 mass % in Si content.

36. A product of pure aluminum or aluminum alloy according to claim 35 wherein at least one surface of the component is exposed to a fluid containing an acid component or alkaline component.

37. A product of pure aluminum or aluminum alloy according

to claim 30 wherein the component has a portion comprising a core layer of pure aluminum or aluminum alloy, and two Al-Si alloy layers covering respective opposite surfaces of the core layer, and an intermediate layer of pure aluminum is formed
5 between one of the Al-Si alloy layers and the core layer, the intermediate layer containing Si diffused therein from the Al-Si alloy layer, the Al-Si alloy layer adjacent to the intermediate layer having a portion up to 1.65 mass % in Si content.

10 38. A product of pure aluminum or aluminum alloy according to claim 30 wherein the component comprises a core layer of pure aluminum or aluminum alloy, and two Al-Si alloy layers covering respective opposite surfaces of the core layer, and an intermediate layer of pure aluminum is formed between each
15 of the Al-Si alloy layers and the core layer, the intermediate layer containing Si diffused therein from the Al-Si alloy layer, the Al-Si alloy layer having a portion up to 1.65 mass % in Si content.

20 39. A product of pure aluminum or aluminum alloy according to claim 37 or 38 wherein the pure aluminum making the intermediate layer has added thereto Zr and/or Mg in a total amount of 0.1 to 0.25 mass %.

25 40. A product of pure aluminum or aluminum alloy according to claim 37 or 38 wherein the intermediate layer has a thickness in a proportion of 5 to 25% of the entire thickness taken as 100% of the component.

41. A product of pure aluminum or aluminum alloy according to claim 37 or 38 wherein a surface of the component on the

side thereof where the intermediate layer exists is exposed to a fluid containing an acid component or alkaline component.